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Freeze/Thaw as a Measure of Global Change Responses of the Boreal Land Surface Using Spaceborne Radars

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global change

General Circulation Models (GCMs) project rapid warming in the high latitudes during the next century with major implications on global weather, and carbon and hydrologic cycles. A characteristic of the boreal region that would be impacted by this warming is the temporal and spatial transition of the land surface from a frozen to thawed state. This transition represents the closest analog to a biospheric and hydrologic on/off switch existing in nature, affecting surface meteorological conditions, ecological trace gas dynamics and hydrologic activity profoundly. However, direct evidence to support these boreal warming projections is weak, in large part because of poor climate monitoring capability in these sparsely populated areas. Attempts to overcome the spatial inadequacies of the ground meteorological network using optical/IR satellite systems are severely limited because of poor temporal sampling due to cloud cover and low winter sun angles. In this study we have used microwave data from both spaceborne scatterometers and imaging radars to derive freeze/thaw state. Our work has focused on the boreal regions in Alaska and Canada using 1997/8 NSCAT data and ERS-1/2 data collected over the past 7 years. From these data, landscape freeze/thaw state are being inferred by monitoring shifts in backscatter relative to winter frozen conditions. The inferred landscape freeze/thaw state is validated against temperature measurements obtained from a distributed temperature monitoring network and from meteorological observations located along the spaceborne data transects. A local scale model is used to develop the relationship between freeze/thaw and ecosystem carbon and water flux, and a regional scale model uses the freeze/thaw state as input to estimate regional fluxes. Results from data transects intersecting the Bonanza Creek Experimental Forest in Alaska, and the BOREAS test sites in Canada will be presented.

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